Summary of Comments on Sections 6 & 7 Scope of Work; Revision 01

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General Comments:

There are two aspects of the groundwater/source water risk assessment that continue to get little attention. These are 1) the fate, transport, and migration of NAPL/LNAPL, and 2) the criteria to be considered when deciding whether or not a tracer test is warranted.

1. Evaluating the risk that the facility poses to groundwater is dependent on the understanding of the migration of NAPL (vadose zone) and LNAPL (on the water table) in addition to the fate and transport of the dissolved petroleum contaminants. A simple calculation shows that there is a significant probability that a large release at the Red Hill Facility could contaminate two drinking water sources.
    a. On Oahu a hydraulic gradient of 1 ft./mi, hydraulic conductivity of 3,000 ft./d, and interconnected porosity of 0.05 are representative values. Given these values the groundwater velocity is about 11 ft./d. Using a conservative first order decay rate of 0.007 d^{-1} (the default RT3D petroleum degradation rate) and a TPH concentration of 6,000 ug/L, the dissolved phase plume would travel 6,600 ft. before the TPH concentration decreased to below the EAL of 100 ug/L. The USTs are located closer than this distance from the Red Hill Shaft and the Halawa Shaft. Thus depending on evaluating natural attenuation alone cannot adequately assess the risk the Red Hill Facility poses to drinking water sources.
    b. The validity of the CF&T model is dependent how well the simulated source area reflects that of a large release. Based on the calculation above, considering natural attenuation alone will lead to the conclusion that the Red Hill Facility poses an imminent threat to drinking water sources. This may not be true, so other factors must be considered. Dilution through dispersion will provide significant mitigation of a long and slender plume. A wide plume will not benefit from this mitigating process and the distance a dissolved plume can travel while maintaining a concentration greater than the EAL will be greater. Thus defining a probable LNAPL plume migration path and geometry is critical to a CF&T modeling process. It is also important to understand that doing an LNAPL F&T evaluation is a very difficult undertaking, likely beyond that currently available to the Navy. Resources in addition to professional contactors should be considered.
2. Less than a sentence was devoted to the possibility of conducting a tracer test. At some point the Work Plan process needs to start considering what would indicate the need for a tracer test. The Navy and their contractor have made it clear that they are strongly against any tracer test and thus will delay discussion of a tracer test as long as possible hoping it will go away. To prevent this tactic

of passive evasion the sooner the criteria for the tracer test decision is agreed upon the better the chance the decision will be merit based rather than convenience based. A suggested criteria would that a tracer test would be done unless the Navy can demonstrate with a high degree of the confidence, the groundwater flow paths and velocity have been properly evaluated by the groundwater investigation. The alternative to a tracer test would an evaluation using in-situ tracers or more sentinel wells.

In numerous places throughout the SOW/WP the replacement OWDFMW-1 is stated (e. g. Page 6, Line 41; Page 6, Line 41; Page 8, Table 1; Page 22, Lines 12-18). Although there is no problem with drilling a new well, due to the large cost invested the Navy should review and fully understand the problem with the existing well. The *Remedial Investigation Phase II – Red Hill Oily Waste Disposal Facility – Halawa, Oahu, Hawaii – Volume 1 Technical Report* (EarthTech, 2000) details the drilling and installation of the basal monitoring wells in the Oily Waste Disposal Facility. Pages 2-9 and 2-12 provide a description of the five basal aquifer borings in the OWDB, Appendix C contains the geologic boring logs. For each well groundwater was not encountered until significantly below the expected depth. Once groundwater was encountered it rose up in the borehole indicating confined conditions for all wells drilled in this area. The elevation where groundwater was first encountered varied from -20 to -1 ft. msl, well below the static water level of about +20 ft. msl. The top of screen elevation for OWDFMW-1 is about +4 ft. msl, above the confining layer, but below the water table. However, the solid rock of the confining layer is essentially a solid casing that extends below the water table. It seems little will be gained in installing a new well near the existing OWDFMW-1 location unless the extent of the confining layer is better defined.

Specific Comments

Page: 1, Lines 21-28

- This paragraph refers to comments that resulted in the disapproval of the previous WP/SOW. It would be helpful if these comments were added as an appendix.

Page 6, Lines 4-5;

- This is a general comment to emphasize the importance of this bullet. Groundwater flow patterns in the Moanalua/Red Hill/Halawa area are poorly understood. The most important outcome of this investigation is to get a much better understanding of the groundwater flow and how this knowledge can be used to predict contaminant migration.

Page 18, Lines 10-16

- An electrical geophysics survey is proposed in an effort to locate NAPL. The SOW/WP correctly points out that this technology may not be able to produce the desired results. UH is currently looking at various geophysical methods in detail for this area and the Pearl Harbor Aquifer in general. It would be beneficial, that prior to investing significant capital in a geophysics survey, the Navy and their contractors meet with UH and collaborate efforts and knowledge.

Page 22, Table 7

- It would be desirable to state up front that the purpose of the monitoring well network is to ensure migration of contamination cannot move from the source area to critical receptors without being detected. The term "sentinel well network" seems to imply this is the purpose, but is not stated.

Page 24, Lines 14-20 and Page 25, Line 2

- This section is dealing with well location and elevation surveying. This effort is critical to the groundwater investigation and some additional detail is very desirable. A reference to and definition of the requirements of a first-order leveling survey should be stated, since this is standard requested by the USGS. It also seems that a precision of 0.001 ft. is not attainable. If this is a mistake it should be corrected. If that is the precision intended then it should have further explanation.
- The reference to Kenney (2010) does not seem to be appropriate. The primary concern in the proposed survey is getting a TOC elevation that is accurately referenced to a common datum for wells that are separated by miles. Kenney (2010), while specifying a precise vertical accuracy, is intended for surveying in a stream gaging station. The vertical datum for a stream gage can be arbitrary as the surveyed area is very local. This is not the case for defining the groundwater elevation over the Red Hill model domain.

Page 28, Lines 5-16

- The monthly oil/water interface measurements should be added to the data considered since water levels are taken during this task and provide fairly good temporal resolution that covers several years.

Page 27, Line 2 (and entire section 3.5.1)

- The USGS is currently working on a groundwater flow that includes the Red Hill area. UH is also, in collaboration with the USGS, conducting groundwater research in the area that includes Red Hill and advanced groundwater modeling. Included in the groundwater investigation/modeling task descriptions should be a review of these efforts and how the results of these investigations can be integrated with the Red Hill groundwater investigation efforts. Not collaborating between groundwater investigations efforts could result in conflicting conclusions about groundwater flow patterns in the Red Hill Region. If such a conflict should arise, it is likely the NAVFAC/AOC effort will have the least credibility. This could likely invalidate a large investment incurred to do the groundwater investigation.

Page 30, Line 3 (and entire section 3.6.1)

- A CF&T model is a difficult and time consuming process. The model runs take hours and data required to validate a petroleum contaminant transport model are very difficult if not impossible to acquire. As the model planning process moves forward, NavFac and the regulators should consider what the realistic expectations of the modeling effort are and revise the approach as needed. To not do this could result in a very expensive effort that produces a poorly validated model that will always be questioned.

- The process of natural attenuation and other plume retardation are known to exist with great confidence. However, the rates of which the processes occur have not been quantified for a basalt aquifer. It seems almost certainly that this investigation will use values for these parameters without a method to validate their accuracy. This is not due to lack of talent on the part of the investigators, but rather due to the large uncertainties involved such as where previous plumes or contaminated leachate has reached the aquifer, the position of the monitoring points relative to the plume distribution, the relative impact of sorption vs degradation, and the individual degradation rates for the TPH species. Use of a high level F&T model such as RT3D or MT3D may not be appropriate due to the lack of validation data. Options include:

    1) Model the transport on an in-situ species that has a measureable distribution and known transport characteristics. Chloride (Cl) would be a good candidate. The Cl transport model could be validated with much greater certainty than a TPH F&T model alone. TPH transport modeling based on a validated Cl transport and using conservative sorption and degradation coefficients can then be done with a much degree of confidence.

    2) Introduce a dissolved plume in the groundwater, i.e. do a tracer test, and model the results. Again do the TPH transport model using the validated tracer model with conservative degradation and sorption coefficients.

    3) Use MODPATH for the F&T modeling. MODPATH simulations can be setup and run in a matter of minutes compared to hours for MT3D simulation. A common use of MODPATH is delineating setback zones using reverse particle tracking. A time of travel from maximum contaminant concentration to compliance with an EAL can easily be calculated using a conservative first order decay constant. The question a reverse particle tracking simulation would answer is how close the LNAPL plume can get to a critical receptor and not exceed an EAL. This seems more informative than modeling an arbitrary and stationary LNAPL footprint as a source area.

    4) Finally, due to the effort invested, the groundwater flow and CF&T models should be thought of as living documents. A process should be incorporated for the regular update and revision of the models as new data and insight becomes available. Should a major release occur, having these models readily available would be invaluable.